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# State of Radiation Protection in Bulgaria

*Dolchinkov Nikolay Todorov*

## Abstract

In the months of February and March 2017, I conducted a survey among 3 population groups and 392 participants on the state of the systems for monitoring and alerting the population, so the information received is up-to-date. The information received and summarized should not be taken as a constant, since the situation is changing dynamically, both in terms of the political situation in Bulgaria and the region and the intentions of our neighbors in relation to sites that present radiation risks and in terms of meteorological elements that influence possible radioactive contamination. Particularly dynamic is the development of meteorological elements that need to be analyzed very thoroughly in the event of a nuclear accident or incident. The results and consequences of the closure of uranium production and its processing in Bulgaria, as well as the storage of radioactive waste in Bulgaria, are shown. The results of the study are presented, diagrams are presented, and analyses and directions for follow-up are made.

**Keywords:** Bulgaria, disclosure systems, population, radiation risks, radioactive background, radioactive waste

## 1. Introduction

The topic of radiation safety is very painful for society. Despite its timeliness, its relevance has not diminished over the past 30 years. In order to increase the monitoring of the radioactive situation, the nuclear accidents in Chernobyl in 1986 and in Fukushima in 2011 played a major role [1]. Simultaneously with the use of the atom for peaceful purposes, over the past 2 years, there has been an increase in the development of new and advanced nuclear weapons. Even in recent months, there has been intense talk about ending the operation of the Nuclear Weapons Convention by leading world powers [2–4].

Bulgaria is at the forefront of Europe, Asia, and Africa where people, technology, weapons, and smuggling are being deployed. This, along with the increased terrorist activity in Europe and the banging of weapons around Bulgaria, leads to a concern in part of society [5]. We cannot be indifferent to what kind of world we live in and what happens around us.

All of this has led me to make a survey of the population to what extent it is aware of the problems of radiation safety and what each of us should do in the event of a radiation accident in Bulgaria or near Bulgaria which will lead to an increase of the natural radioactive background [6]. The extent to which the public is aware of the procedures and actions to be taken in changing the radioactive situation should

be increased. As a purpose, I set myself to explore the real state of public awareness and analyze information to identify awareness-raising measures. I segmented the community to get more reliable information to summarize and analyze. In order to achieve the purpose, I set up a questionnaire with specific questions, and I made a preliminary study of the problem [7].

Based on the studies, aggregation of information, and analysis of results, a questionnaire containing 20 questions was developed. Inquiry included issues covering the overall vision of radioactive background monitoring systems, population disclosure, action by competent authorities and bodies, and their interaction. Together with these basic radiation protection values, the respondents also expressed their opinion on the main factors that could lead to a radiation accident and the manner of distribution of the radioactive particles, isotopes, and rays in terms of the meteorological elements that influence them. The volume of survey questions was chosen so that it could fully cover the research problem from all the relevant points of view, while not being boring for the survey participants. As the number of questions asked increases, there is a danger that the respondents will not pay due attention to the problems raised and those in the second part will not pay due attention [8]. If it goes to the other extreme and there are too few questions, then we will not get enough of the amount of information we need for the analysis and its next lessons.

## **2. The main part**

The survey was conducted in February and March 2017 so that the information received is current at the time. The resulting and aggregated information should not be considered as a constant because the situation changes dynamically, both in terms of the political situation in the region and the intentions of our neighbors regarding the sites that represent both the radiation risk and the meteorological elements that affect any radioactive contamination [9]. Especially dynamic is the development of meteorological elements, which should be analyzed very thoroughly in the event of a nuclear accident or incident.

The study was conducted in three groups of respondents. The first group consisted of radiation protection and nuclear physics specialists, who have a deeper understanding of the problems, and their opinion has a greater weight. Due to the specificity of the problem, people from different institutions working in this or near area were involved, but considering the research problem, their circle was not large—38 people responded to the survey. In the selection of these specialists, I endeavored to cover a broader range of institutions—Kozloduy NPP, HEI, BAS, Ministry, RNI at the Bulgarian Academy of Sciences, and others. Due to the avoidance of subjective opinion in the survey, employees working or close to the Vasil Levski NMU did not participate.

The second group of people included randomly selected individuals in different age groups and educational qualifications from all over the country. In this category, the respondents that answered were 196 people of different age, gender, and education.

I also made a study among students in the first course at the Vasil Levski NMU, and the results were also processed and analyzed independently. It was attended by 158 trainees who have received initial training in nuclear, chemical, and biological protection and have some basic knowledge of nuclear accidents and their actions. In summarizing the results, the opinions of the three categories of people are considered separately, making only comparisons, but not a general presentation of the problem because these issues are specific and some

know-how in the field of radiation protection is needed to be able to respond appropriately.

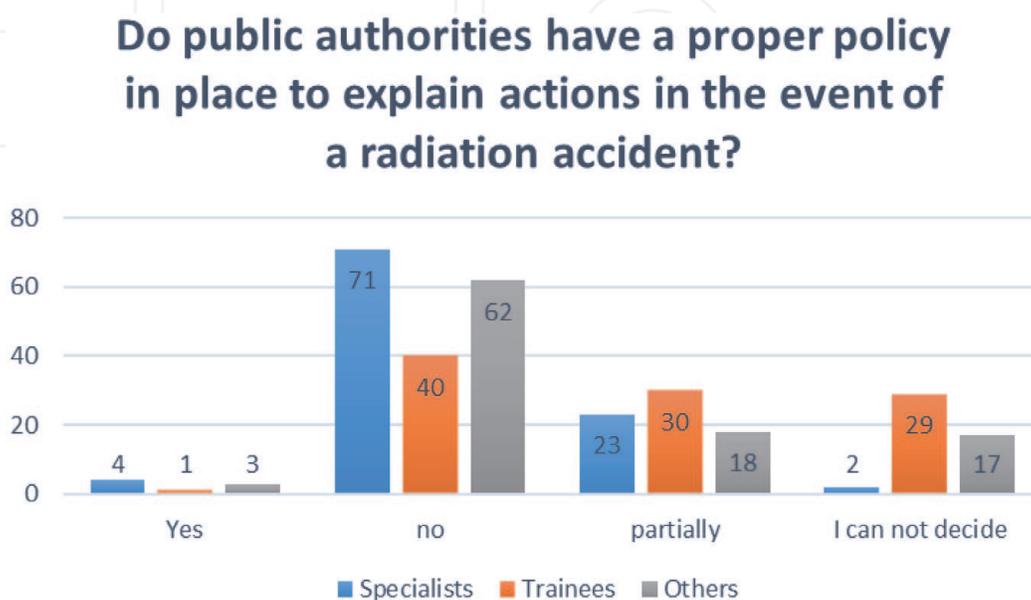
The questionnaire from this study is attached in this thesis—Appendix.

Upon completion of the survey among all categories of learners, the results obtained were edited by me and summarized in a tabular form, which is attached to the dissertation in Annex 17. Based on the summarized data, we can make several statements.

1. The population is not aware of the measures to be taken by the competent state, municipal, and other authorities in the event of a radiological emergency. This potential problem is viewed with disregard and disinterest by the majority of the population, regardless of gender, age, ethnicity, and education. Older people are more concerned about the problem than young people.

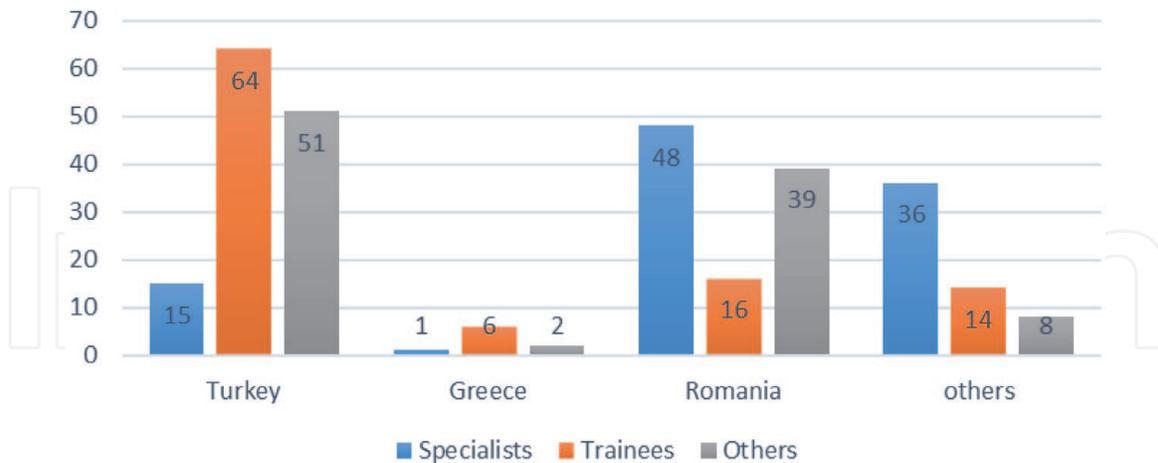
In responding, respondents with a higher level of education are more interested in the affected aspects of everyday life and are at least partially aware of the problems related to radiation protection, while those with secondary and lower education are ignorant and uninterested in the discussion in the consultation. Hence the fact that the majority of the respondents are not satisfied with the state's policy regarding the actions and measures taken in the case of a radiation accident (**Figure 1**).

2. There is a very large difference in the responses of the different groups of respondents as to where the greatest danger for radioactive contamination and a possible nuclear accident comes from. Here the trainees and the random respondents give Turkey the greatest danger, while those who are more familiar with the problem have turned their attention to Romania. All respondents have unanimously indicated that Greece is not a nuclear threat to Bulgaria, while others say Russia, Ukraine, Hungary, the Czech Republic, and Slovenia, but there is no clear potential other subject that would endanger our radiation security. Despite differences of opinion, they are emerging as major potential contributors to radiation pollution in Romania and Turkey. The opinion given is illustrated in **Figure 2**.



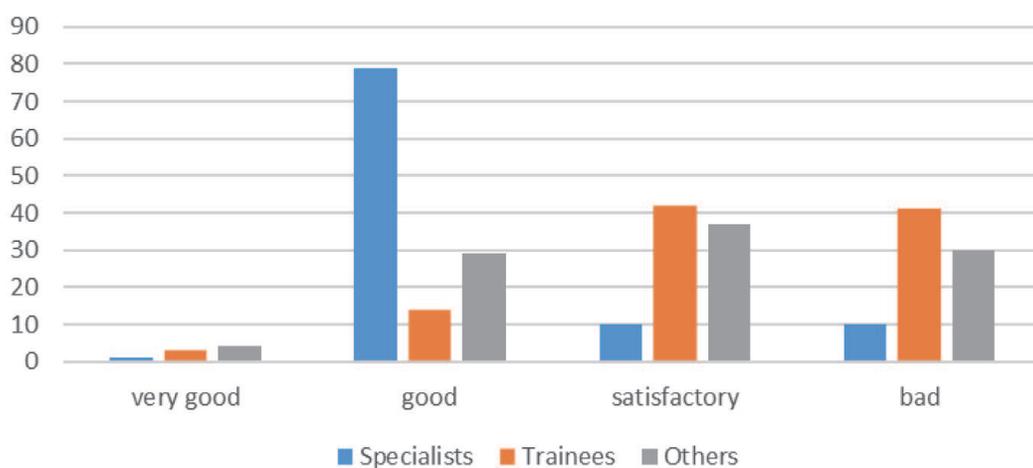
**Figure 1.**  
*Poll results.*

### Countries presenting a potential nuclear threat to Bulgaria



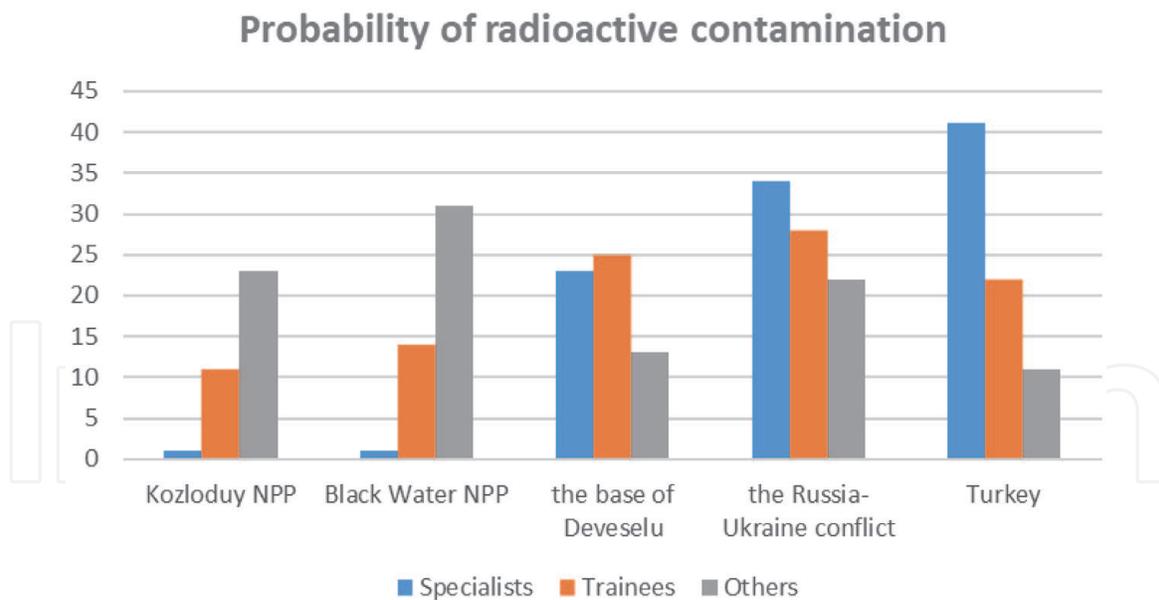
**Figure 2.**  
Bulgaria’s threat of a radiological emergency.

### What is your opinion about the state of radiation protection in Bulgaria?



**Figure 3.**  
Answer a question “what is your opinion about the state of radiation protection in Bulgaria?”

3. According to the results of the study, the state of radiation protection in Bulgaria has gaps, and the experts give a higher assessment of reality than the other two groups.  
The group of learners and people, selected randomly, gives a lower score, as the lack of information influences this. People with higher education also give higher marks than people with secondary and lower education (**Figure 3**) [10].
4. On a detailed examination of the main sites where nuclear facilities are or could be located, there is also a different degree of suspected danger, the most serious of which is reported by all respondents from Turkey, where the specialists give 37% and the other participants give 57–64%. The other possible answers are given in roughly the same range regardless of the type of category. It is quite clear that the Kozloduy NPP is the most reliable nuclear facility in the region and that radioactive contamination is unlikely to occur (**Figure 4**).



**Figure 4.**  
*Potential carriers of radiation risk.*

When reading the survey data, it is clear that a large part cannot judge whether the sites in Romania are potentially dangerous because of the lack of the necessary information.

This leads us to the conclusion that a large part of the population in Bulgaria is not familiar with our neighboring countries and we are not interested in enriching the knowledge about our safe living not only in terms of radiation safety but also in terms of other potential dangers and risks. These data can be found in Annex 17, and these statements are also based on these considerations.

Although a referendum was recently held in Bulgaria on whether to develop nuclear power by building new capacities in the consultation, I included such a question. The predominant response was to the Belene NPP, with approval of 80% for nuclear and safety specialists, while for the random respondents, the positive response was 54%. Accordingly, the disapproval was highest in the last category which is 46%, and in the experts it was only 20% [11].

With a ready-made one and almost ready-made second reactor, it is most reasonable to install them on the approved site and put into operation and in Bulgaria to regain its dominant position in the energy exporter region; otherwise, in the near future, we may become extremely energy dependent.

5. The number of people familiar with the National Automated System for Continuous Radioactive Background Control and the system for forecasting the spread of radioactive contamination in case of a major nuclear accident of the National Institute of Meteorology and Hydrology is too small. Even among the people who work in this area and who are gravitating around these problems, they are not so prepared for information to fulfill their direct duties. In the consultation, a comment was often made that it is not my direct duties and I do not care.

The percentage of people familiar with the systems varied between 2% and 26%, which is a very low percentage. On this basis, a high percentage of people who have responded positively to the effectiveness of these systems cannot be expected. More than half cannot assess the degree of coordination

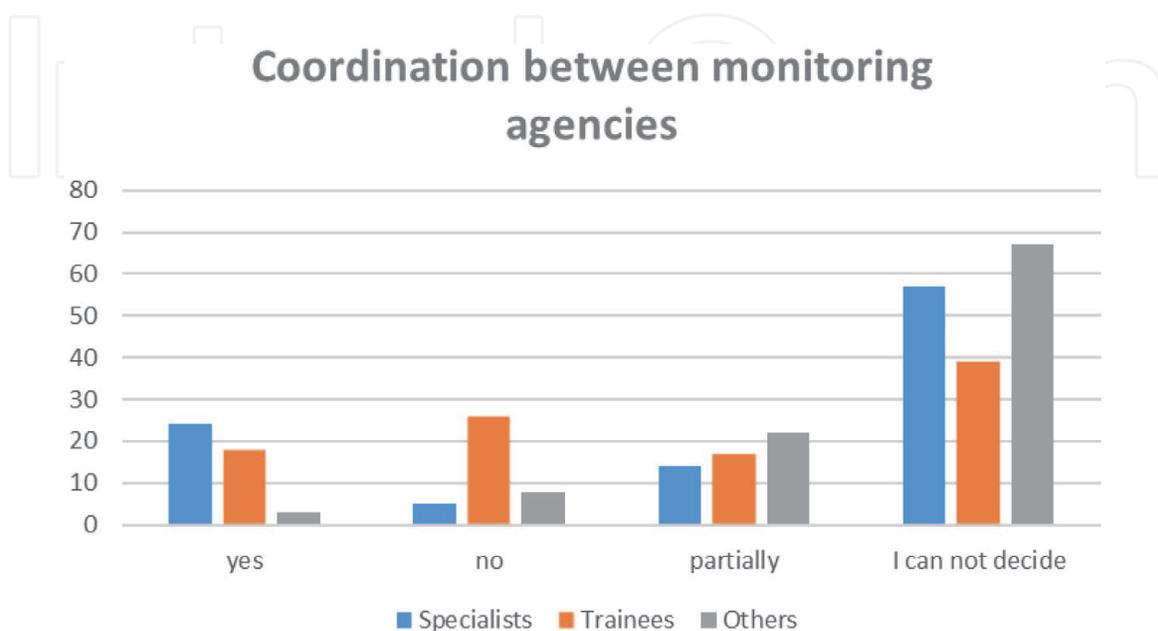
between organizations that monitor the radiation situation and manage the activity of managing a situation with increased radioactive background and take measures to reduce and limit the negative impact on people and the environment [6].

The set of responses to the issues of coordination of the responsible authorities and agencies gives us a real picture of the population's interest in the real radiation situation, how it is monitored, and what actions should be taken to reduce the negative impact. In this respect, the competent state authorities must necessarily improve their work among the population and their coordination among themselves. Only in this way would they weigh in their place and raise their authority, and the population would have greater faith in their actions.

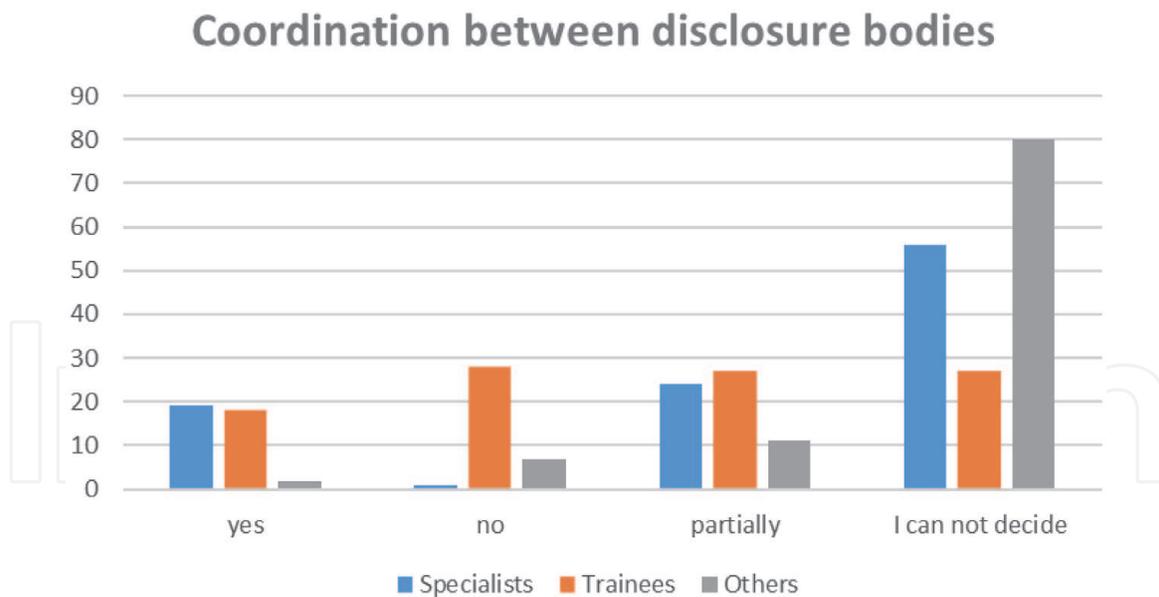
Here too, the predominant is "I cannot judge" again, which is indicative of the fact that a large part of even the experts cannot judge the real picture of the state of coordination among the most important authorities in the field of radiation protection. It is imperative that this responsible work is carried out by professionals and that there is no continuous reorganization of structures and people, depending on the political situation. The professional qualities of the employees should be evaluated, not their political orientation. For example, Italy may be given a position where, despite frequent political changes and elections, the Secretary of the Ministry of Foreign Affairs has headed for more than 30 years, and this creates the security of the institution he represents.

**Figure 5** shows the assessment of the coordination between the responsible radiation monitoring institutions, according to the respondents.

Here too, the predominant is "I cannot judge" again, which is indicative of the fact that a large part of even the experts cannot judge the real picture of the state of coordination among the most important authorities in the field of radiation protection. It is imperative for these important units for the state to become professionals and not to become a continuous rockade of structures and performers, depending on the political situation. For example, Italy may be given a position where, despite frequent political changes and elections, the Secretary of the Ministry of Foreign Affairs has headed for more than 30 years, and this creates the security of the institution he represents.



**Figure 5.** Coordination between departments that monitor the radiation situation.



**Figure 6.**  
*Coordination between notifying authorities when changing the radiation situation.*

**Figure 5** shows the assessment of the coordination between the responsible radiation monitoring institutions, according to the respondents.

Similar is the picture in the assessment of the coordination between the departments, which they announce when changing the radiation situation in the territory of Bulgaria [12]. There is a peculiarity in responding learners—their opinions are almost equally divided between the four responses. The explanation for this is due to the fact that they have recently received training on nuclear, chemical, and biological accidents and catastrophes, have visited the radiation and other protection authorities at the current Directorate of the Ministry of the Interior, and are under the impressions of the specialists working there. In the other two categories, the fourth answer is very clear, namely, “I cannot judge.” This is shown in **Figure 6**.

All inquiries about the need for more and better quality exercises and annual training of staff responsible for monitoring the radiological situation and especially for government, local authorities, and other non-governmental or voluntary organizations are all categorical.

6. The majority of respondents from the second and third groups did not make suggestions, but there are also very reasonable and reasoned ones. Together with the suggestions of the employees in this field, we can bring them to the following summarized suggestions:

- The need for more quality annual exercises of all responsible institutions.
- Improving interaction between follow-up and disclosure organizations.
- Conducting seminars and refreshing effective staff training.
- To have up-to-date and accessible information on the radiation situation by explaining to the competent authorities and the media where and how the population will receive it.
- In the current development of the technique, the publicity should include, in addition to national television and radio and other electronic media and mobile operators, this being legislatively regulated.

- Increase the control points for monitoring the radiation background, taking into account the research and analysis.

### **3. Conclusions**

1. The data from NASCRPF are used by the competent state authorities for preventive measures and for the organization of measures aimed at limiting the impact on human and the environment of radioactive particles, rays, and isotopes.
2. The lowest radioactive background in Veliko Tarnovo is the lowest.
3. The awareness of both professionals and voluntary formations and the population itself is low, as shown by the survey data.
4. It is necessary to carry out an explanatory work among the population in order to improve its awareness. It is also necessary to carry out exercises for changing the radioactive situation.
5. The radiation gamma background of the neighboring atmospheric layer is within the boundary of the country's background values without significant deviations over the last 20 years. Surface water currents and basins are in good radiological state and are controlled by the control bodies of the EEA in accordance with the applicable regulations. As far as the radiation status of the soils is concerned, no values are found above the backgrounds of the periodic and extraordinary measurements made during the last 15 years.
6. A clear program has been developed and implemented in terms of nuclear safety with the participation of all levels of state and local government. A National Strategy for the Safe Management of Spent Nuclear Fuel and Radioactive Waste has been developed, and the necessary control has been introduced on these activities. It is a weakness that changes the position of the bodies involved in this activity, there is an outflow of specialists, and the thread between the state and municipal authorities and the voluntary organizations is broken.
7. Government documents were adopted to solve the problems with the consequences of priority liquidated sites of uranium mining and uranium processing. There are still weaknesses and under-reclaimed sites and unsealed former mines where environmental pollution from leakages and soils containing uranium and other radioactive isotopes may occur.
8. Research shows that specialists responsible for radiation protection at secondary and lower levels are not sufficiently theoretically and practically prepared and the exercises conducted are not effective. It is necessary for these specialists to undergo refresher courses every year for both radiation and accidents and other accidents. This would help to increase their knowledge, skills, and competencies. The management of NASCRGF is carried out professionally, according to the requirements of the international organizations and according to the domestic and international legislation. An extension is needed from the team of specialists working to monitor the radiation background in Bulgaria, as well as improving their financial and resource security.

## Appendix

### Annex No. 1

#### THE ANALYSIS OF THE STATUS OF RADIATION PROTECTION IN BULGARIA

... .. *name and family, organization* ... ..

1. **What is your opinion about the state of radiation protection in Bulgaria?**
  - a) very good;
  - b) good;
  - c) satisfactory;
  - d) bad.
2. **Is the population aware of the rules for action on a radiation accident?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
3. **Do state authorities conduct a proper policy to explain the actions of a radiological emergency?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
4. **Which neighboring countries pose a threat in terms of a potential nuclear threat?**
  - a) Turkey;
  - b) Greece;
  - c) Romania;
  - d) Other (please specify).
5. **Do you consider that the Kozloduy NPP is a safe plant in normal operation?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
6. **Do you consider that the NPP “Cherna Voda” in Romania is a safe plant in normal operation?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
7. **Do you consider that the functional base in Deveselo in Romania by the US missile defense system represents a danger from the point of view of radiation safety?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
8. **Do you think that the escalation of tensions between Ukraine and Russia and the events in the Crimea could pose a threat to our nuclear safety?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
9. **Do you believe that Turkey’s policy can affect the security of Turkey’s nuclear power plants and the storage of rockets that can carry nuclear weapons?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
10. **What is your opinion on the Belene project?**
  - a) it must be finished;
  - b) it must not be completed;

11. **Do you know the National Automated System for Continuous Radiation Background Control (NASCRBC)?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
12. **Is NASCRBC efficient for you?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
13. **Does our European Radiation Disaster Response System meet our requirements?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
14. **Do you know the system for forecasting the spread of radioactive contamination in the event of a major nuclear accident at the National Institute of Meteorology and Hydrology?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
15. **Is there sufficient coordination between the agencies that monitor the radiation situation?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
16. **Is there sufficient coordination between the departments that disclose the population in case of a radiation accident?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
17. **Do you think it is necessary to do more and more qualitative exercises for changing the radiation situation?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
18. **Do you consider that it is necessary to increase the qualification of the radiation protection officers in the basic units working on a voluntary basis?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
19. **Does Bulgarian legislation comply with current European and international legislation in the field of radiation protection?**
  - a) yes;
  - b) no;
  - c) in part;
  - d) I cannot judge.
20. **What recommendations do you have for radiation monitoring and public disclosure systems?**

**Thanks for your time and responsiveness!  
Nikolay Dolchinkov, NMU “Vasil Levski”.**

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